Chapter 4 – Resource Options

This chapter identifies and describes commercially available resources and addresses transmission issues that can impact market purchases and seasonal exchanges.

An essential mission for integrated resource planning is to identify and evaluate a broad range of resources (as required by Engrossed Substitute House Bill 1010), including conservation and generation resources. This chapter contains information about resources currently available to electric utilities considered for this Integrated Resource Plan (IRP). These include additional conservation resources; nonrenewable generation resources (natural gas); renewable generation resources (wind, geothermal, biomass, and landfill gas); hydro efficiency improvements; power purchase contracts; and spot power purchases from the Western wholesale energy market. Utility-scale resources that may become cost-effective in the future, such as solar and wave energy, are detailed in Appendix B - Electric Generating Resources and Appendix C - Assessment of Tidal Energy Resources in Puget Sound and Wave Energy Resources in Grays Harbor, Washington. In Appendix D - Assessment of Distributed Generation Opportunities, the potential for small-scale generation at the customer site is explored, and in Appendix E - Demand Response Assessment, customer load control is considered.

Conservation Resource

Conservation is Seattle City Light's first choice as a resource to meet growing demand for power. Through its conservation programs, City Light partners with its customers to use energy-efficient equipment and practices in homes and buildings. Investment in conservation is advantageous for the utility and its customers, and delivers other benefits as well, such as avoided higher-cost generation, deferred transmission and distribution investments, reduced air pollution and greenhouse gas emissions, and lower customer bills. As a low-cost, low-carbon alternative to other types of energy generation, conservation is the foundation of Seattle City Light's Integrated Resource Plan, the Mayor's Climate Action Now Campaign and the utility's plan to meet the requirements of I-937. Acquiring conservation is also a good policy in a transforming energy market because it avoids price risk and availability risk. Seattle City Light has provided highly effective conservation programs for over 30 years.

Characteristics

Utilities must be able to match resources to load. Dispatchability refers to a utility's ability to control the output of a generation resource in real time. More readily controlled resources, such as simple cycle combustion turbines, have a greater degree of dispatchability. Energy efficiency measures are not dispatchable.

Conservation resources have seasonal, daily and hourly load shapes. An energy-efficient water heater saves more energy in the morning than other times of the day, because hot water use is greatest in the morning. An energy-efficient window installed in a home with electric heat will save more energy in the winter, when heating is used the most.

Conservation measures can be either discretionary or lost opportunity resources. Discretionary conservation measures can be implemented at any time within practical limits. Discretionary conservation usually involves ad hoc energy efficiency improvements by an existing City Light customer, whereas lost opportunity conservation must be captured when a new building is built or when a new appliance is installed; if not, the conservation benefit can be lost. If energy efficient lamps and fixtures are not installed in a new building at the time of construction, the potential for energy savings and operational efficiency is lost until the building is replaced or retrofitted in the future at a much higher cost.

2006 Conservation Potential Assessment

The Conservation Potential Assessment (CPA), conducted by energy analysis firm Quantec, examined available energy savings in the residential, commercial and industrial sectors in City Light's service area. It considered dozens of conservation measures, with hundreds of permutations across segments and construction vintages, distinguishing between discretionary and lost opportunity resources. The study also incorporated non-energy benefits. Information gathered in the CPA was used to prepare both the 2006 and the 2008 IRPs.

Technical potential refers to the maximum savings that could be achieved if every cost effective efficiency measure were implemented in every customer facility - residential, commercial and industrial. Achievable potential is the portion of technical potential that will likely be viable over the planning horizon, given market barriers that could limit implementing demand-side measures.

To determine the achievable conservation potential available to meet resource needs, the CPA first attempts to identify all technical or demand-side resource opportunities from conservation that could be captured regardless of costs or market barriers.

Achievable potential was assumed to be 70% of the technical potential for the CPA and the 2006 IRP. In order to comply with Initiative 937 requirements, the percentage for achievable potential assumptions was revised to 85% for all discretionary measures (existing buildings and equipment) and 65% for all lost opportunity measures (new buildings and equipment) for the 2008 IRP. The result was an achievable cost-effective conservation potential that totals 159 aMW over the 20-year planning horizon. Only the discretionary portion of the total 20-year cost-effective potential of 159 aMW was accelerated for the portfolios.

Table 4-1 shows the total amount of conservation potential estimated to be achievable over the 20-year planning period. The table shows the amounts of conservation potential that could be achieved across a series of levelized cost groups. The data shown in the table constitute a “supply curve” for conservation resources.

Table 4-1. 20-Year Cumulative Achievable Potential by Cost Group 2006 IRP vs. 2008 IRP

Cost Group ($/MWh)	2006 IRP (aMW)	2008 IRP (aMW)
Up to 10	18.4	16.3
10 to 20	46.6	57.1
20 to 30	45.2	47.4
30 to 40	13.8	19.7
40 to 50	7.9	8.7
50 to 60	8.8	10.0
Cumulative < $60 /MWh	140.7	159.2

The 2006 IRP identified acceleration of conservation programs as a promising resource strategy and recommended that the costs, benefits and feasibility of accelerating conservation be examined in the 2008 IRP.

Modeling Conservation in the 2008 IRP

One of the outcomes of analysis for the 2006 IRP was a strong recommendation to identify the costs of accelerating conservation in City Light’s service territory. To that end, Conservation staff retained consulting assistance to update the Conservation Resource Potential Assessment in 2007 for the 2008 IRP. Conservation costs were reassessed based upon two significant changes: 1) the increase in costs for accelerating conservation; and 2) the changes required in order to use assumptions for achievable conservation potential resulting from I-937 requirements. The new rules for implementing I-937 require a change in assumptions for calculating achievable conservation potential.

In I-937, the target for renewable resources is a percentage amount based on the average load of the previous two years. To the extent that conservation reduces load, it also reduces the need to purchase expensive new renewable resources. Thus, results of this information gathering and reassessment demonstrated that even with the additional costs of accelerating conservation, total costs remained well below the cost of new generating resource alternatives.

In the 2006 analysis, staff modeled alternative levels of conservation in the various portfolios and then compared them in order to identify the most cost-effective level. In 2007, however, the new conservation costs were modeled relative to the 2006 levelized portfolio (avoided) cost of $60/MWh for new resources. City Light staff used the avoided cost approach for several reasons: First, the avoided cost already incorporated a thorough analysis completed for the prior IRP; second, conservation potential was unlikely to have changed significantly in the relatively short period of time between the 2006 IRP conservation analysis and the 2007 update; last, and most important, the updated conservation cost structure suggested that the $60/MWh was not a meaningful constraint. Under these circumstances, the impact to the targets established for accelerating the pace of discretionary conservation acquisition far outweighed any small, positive or negative adjustments arising from the use of a different methodology. The targets for at least the first decade of the planning period would not change, since the constraints were not theoretical, but physical. In short, City Light found that it should acquire as much conservation as it can, as quickly as possible.

In estimating the pace of accelerating conservation, the model logic does not capture practical considerations. For accelerated conservation, the question does not concern theoretical modeling but implementation: "How quickly can City Light actually 'mine' discretionary conservation from existing buildings?" The answer to this depends on issues such as budgets, customer incentives, staffing, office space, consultants, conservation contractors and schedules.

In Round 1 portfolios, City Light modeled a lower rate of accelerated conservation than in Round 2 portfolios, (well beyond the rate required by I-937), based upon what was then the highest estimate for the pace of acquiring the discretionary conservation. After closely reviewing the numbers, Conservation staff set a more aggressive pace to obtain the discretionary conservation. City Light increased the accelerated conservation used in the Round 2 portfolio analysis, which resulted in lower overall portfolio costs.

A cost effective threshold of $60 per MWh (used in the 2006 IRP) was applied to the Conservation Potential Assessment. The figure was updated by the new achievable potential assumptions-85% of all discretionary resources and 65% of all lost opportunity resources.

Two different series of accelerated conservation were used for the Round 1 and Round 2 portfolio modeling. Table 4-2 reflects the accelerated conservation path used in all Round 1 portfolios.

Table 4-2. Accelerated Conservation in Round 1 Modeling, Annual and Cumulative

	Annual (aMW)	Cumulative (aMW)
2008	8.4	8.4
2009	9.5	17.9
2010	11.0	28.9
2011	12.9	41.9
2012	12.9	54.8
2013	12.9	67.8
2014	12.9	80.7
2015	12.9	93.7
2016	12.9	106.6
2017	12.9	119.6
2018	11.0	130.6
2019	9.5	140.1
2020	8.4	148.5
2021	1.5	150.0
2022	1.5	151.6
2023	1.5	153.1
2024	1.5	154.6
2025	1.5	156.2
2026	1.5	157.7
2027	1.5	159.2

For Round 2 modeling, the degree of conservation acquisition was accelerated further, as shown in Table 4-3.

Table 4-3. Accelerated Conservation in Round 2 Modeling, Annual and Cumulative

	Annual (aMW)	Cumulative (aMW)
2008	10.2	10.2
2009	12.1	22.3
2010	14.4	36.7
2011	15.6	52.3
2012	15.8	68.1
2013	15.6	83.7
2014	12.9	96.6
2015	12.9	109.5
2016	12.9	122.4
2017	12.8	135.2
2018	11.0	146.2
2019	3.0	149.2
2020	3.0	152.2
2021	1.0	153.2
2022	1.0	154.2
2023	1.0	155.2
2024	1.0	156.2
2025	1.0	157.2
2026	1.0	158.2
2027	1.0	159.2

Subsequent to Round 2 modeling, the annual conservation goal for 2008 was scaled back to 8.4 aMW after City light did not receive supplemental budget authority.

Generation Resources

Generation resources produce electrical energy from other forms of energy, such as heat or solar; or potential energy, from wind or falling water. The types of generation resources analyzed for an IRP are proven and commercially available. Generation resources added to City Light's existing portfolio will have characteristics important to City Light's future needs, the most important characteristics being costs, dispatchability, transmission requirements and environmental attributes.

Evaluating the Resources

In considering resources, the IRP team evaluated generation resource types rather than specific projects. The exception to this is a hydroelectric efficiency improvement, the Gorge Tunnel project. Reliable and verifiable information about the each generating technology can be used for the analysis of candidate resources with this approach, which allows an objective and consistent comparison of the results. The process benefits when the IRP focuses on higher-level, long-term strategic issues rather than on the details of specific transactions. Further, if a resource strategy adopted in the IRP calls for City Light to acquire a specific type of generation resource, the information about the resource developed for the IRP can be used as a benchmark to evaluate specific generation projects.

This section provides descriptions of the types of generating resources that were included in candidate resource portfolios and evaluated for the 2008 IRP.

- Hydroelectric Efficiency (Gorge Tunnel II)
- Wind Power
- Biomass
- Landfill Gas
- Geothermal
- Natural Gas-Fired Combined Cycle Combustion Turbines (CCCTs) and Simple Cycle Combustion Turbines (SCCTs)

As research and development continue for new or enhanced types of generating resources, it is difficult or impossible to predict future technological advancements and how they will affect cost, availability and other characteristics of such resources. Thus, most IRPs identify and monitor promising generating resource technologies that may become technically viable and commercially available, but do not include them in the quantitative analysis. Washington state law governing IRPs states that IRPs should contain commercially available technologies and select resources with the lowest reasonable cost. In keeping with state law and IRP best practices, the IRP does not contain forecasts of new technologies or their costs.

Selecting a Range of Resources

The IRP Team followed an open, rigorous and structured process to compare and choose from an array of available resource types, and evaluated more types of generating resources than were included in the recommended resource portfolio. Including a broad range of resource types has advantages, including the assurance that the IRP process is objective and does not prematurely narrow the field of resource alternatives. Each type of generating resource has a unique combination of advantages and disadvantages, including costs, benefits, opportunities and risks. Evaluating a particular resource does not imply a predetermined preference for or against including it in City Light's portfolio.

Analyzing various types of generating resources helps to identify which combinations of new resources can best complement the existing resources in City Light's portfolio. A single type of generating resource is unlikely to meet all of the utility's long-term needs, while a diversified mix of resources is more likely to meet the utility's objectives of maximizing reliability and minimizing cost, risk and environmental impacts. The net impacts of a particular type of generating resource on the utility's overall resource portfolio are often not obvious and can remain obscured if the resource is only evaluated on a stand-alone basis.

Various types of generating resources have proponents and opponents. Quantitative analysis of candidate resource portfolios that combine a range of resource types provides the means to incorporate input from a variety of perspectives. Quantitative analysis of candidate resource portfolios that mix types of resources can produce the information City Light requires in order to select the types of resources included in a long-term resource strategy.

Based on results from quantitative analysis, City Light's candidate resource portfolios contain resources that are known to be commercially viable at costs that are verifiable at the point the IRP is produced. Some resources were not included in the quantitative analysis because their costs are significantly higher than alternative renewable resources or they are not commercially available to City Light. (See Appendix B for detailed descriptions of existing and potential resources.) In the future, City Light may conduct Request for Proposals (RFPs) in order to provide more complete information on resource costs and availability. However, even RFPs are not always reflective of the true cost of a resource due to local market constraints and the bidding strategies of participants in the RFPs.

Costs of New Generation Resources

Rapidly rising commodity prices and a devalued U.S. dollar are driving escalating costs for new resources. Much of the escalation is traceable to rising prices for steel and concrete, as global demand rises for these materials. The cost of wind turbines, many imported from Europe, has grown rapidly as a result of transportation costs and a weak U.S. dollar.

In the next few years, City Light expects to see higher capital costs for resources than represented in this IRP. However, the possibility exists that productive capacity for concrete, steel and wind turbines will increase, causing resources prices to moderate. City Light chose not to adjust resource costs upward for what are seen as primarily near-term market trends. Table 4-4 shows the resource costs used in the 2008 IRP.

Information about the costs of new resources came from many sources, including the U.S. Department of Energy, Northwest Power and Conservation Council, California Energy Commission, and Northwest Utility Integrated Resource Plans. Not all cost information from these sources was consistent, despite adjustments for heat rates, capacity factors and other factors. In these cases, a cost was selected that fell within the middle of the range most frequently used.

Transmission costs for new resources are assumed to be consistent with the BPA's policy for new transmission. This policy is that the BPA will build new transmission as needed by its customers, not to exceed an amount that would increase rates by 5%.

Table 4-4 provides costs and other assumptions for new generation resource options that were evaluated in the 2008 IRP.

Table 4-4. Costs for New Resources

Cost	CCCT	SCCT	Geo- thermal	Wind	Biomass	Landfill Gas
Heat Rate (BTUs/kWh)	6903	9,251			n/a	11,000
Capital ($/kW)	$747	$758	$3,176	$1,734	$2,238	$1,773
Fixed O&M ($/kW-yr)	$11.88	$75.60	$71.92	$34.33	$73.24	$66.12
Wheeling ($/kW-yr)	$18.91	$18.91	$18.91	$18.91	$18.91	$18.91
Fuel	GED Gas Price Forecast	GED Gas Price Forecast	Included in Capital	$0.00	Included in Capital	
Variable O&M ($/MWh)	$2.87	$5.49	$4.63	$1.00	$3.78	$7.66
Integration & Shaping ($/MWh)				$7.82		

Resources Evaluated in the IRP

As mentioned earlier, the most important characteristics in a generation resource added to City Light's current portfolio are costs, dispatchability, transmission requirements and environmental attributes. For each new generation resource evaluated for this IRP, the following basic information was gathered:

- Resource technology and fuel
- Current status and outlook
- Resource characteristics (dispatchability, transmission requirements and environmental attributes)

(See the 2006 IRP Draft and Final Environmental Impact Statements, and the 2008 Addendum, for additional information on environmental impacts.)

Hydroelectric Efficiency Improvement

City Light has pursued ongoing efficiency improvements to the hydro plants that it owns, including replacement of turbines and runners, on a prescribed schedule. The new hydroelectric resource considered for this IRP is an efficiency improvement at Gorge Dam, part of City Light's Skagit Project.

Hydroelectric Efficiency Improvement	
Technology & Fuel	The Gorge Reservoir supplies water to the powerhouse through a single tunnel. The efficiency improvement would involve the installation of a second tunnel that would decrease flow velocities, reduce energy lost to turbulence when water flows at high velocity, and reduce the frictional losses that occur between the water and the tunnel wall, thereby increasing the effective hydraulic head. Greater power production would result for the same amount of water. This efficiency improvement would increase annual generation by about 5.40 average megawatts. In January, generation is estimated to increase by 5.14 average megawatts.
Current Status & Outlook	A FERC license amendment and other permits would be required for this project. It would be completed in about eight years, with the first three years devoted to the FERC license amendment process.
Characteristics	**Transmission requirements.** Already available **Dispatchability.** The output from the hydroefficiency would be dispatchable. **Environmental attributes.** The generation from the hydroefficiency improvement would be a renewable resource. Specific environmental impacts will be evaluated during project design and planning.

Wind Power

The use of wind power has increased rapidly, making it the predominant renewable resource technology in the Pacific Northwest, where the installed capacity of wind power projects has increased from zero to more than 1,700 megawatts in the last decade

Wind Power	
Technology & Fuel	Wind power is the process of mechanically harnessing energy from the wind and converting it into electricity. The amount of wind power that can be produced at a given place is dependent on the strength and frequency of wind. Wind velocity and frequency is particularly important, because the quantity of power increases as wind speed and frequency of wind increases. Wind turbine generators are grouped together in order to maximize energy output and minimize costs. Wind power has no fuel cost. However, lease payments to landowners are a cost of accessing the wind "fuel".
Current Status & Outlook	The Northwest Power and Conservation Council (NPCC) estimates economically viable potential for wind power in the Pacific Northwest at approximately 5,000 megawatts. State requirements for renewable resources, including Initiative 937 in Washington, are driving the development of new wind power. In this region alone, during the last 10 years the installed capacity of utility-scale wind power projects has increased from zero to more than 1,700 megawatts.
Characteristics	**Transmission requirements.** The cost of transmission for wind power is higher per megawatt-hour than for other generating resources because it has a low capacity factor. **Dispatchability.** Wind power is not a dispatchable resource. One approach for firming up the intermittent generation from wind power projects is to coordinate their operation with dispatchable resources (e.g., combustion turbine generation) or with resources that have the ability to shape or store energy (e.g., hydroelectric generation). **Environmental attributes.** Wind power is renewable and does not consume fossil fuels or produce air emissions. Primary environmental concerns are bird and bat mortality and visual impacts.

Biomass

Biomass generation is the production of electricity using biomass fuel, made from organic material that can be burned or converted into a combustible material. Examples of biomass fuels that can be used to generate electricity include wood waste (e.g., residues from forest thinning, logging and mill processes), methane produced at wastewater treatment plants, and methane produced from the decomposition of animal manure, agricultural residues and energy crops. For the 2008 IRP, wood-waste plants were modeled.

Extremely large amounts of biomass fuels are usually not available near any single location, thus incurring transportation expense. Most future biomass plants will typically have generating capacities of between 10 megawatts and 25 megawatts.

Biomass	
Technology & Fuel	The raw forms of many biomass fuel sources have low energy content, so generating electricity from biomass requires large quantities of organic material. Biomass is converted into fuel using thermochemical or biochemical technologies. Both types of technology generate electricity by processing biomass into a combustible fuel and burning it. Conventional steam-electric turbines with or without cogeneration are the chief technology for electricity generation using wood-derived fuels.
Current Status & Outlook	Limited opportunities to acquire these types of generating resources are expected, and costs and other characteristics are situation-specific. While woody residue is available in large quantities, the high cost of collection and transportation limits the economics of plants distant from fuel sources. Technical difficulties and seasonality of fuel availability preclude significant use of agricultural field residues for generation. A small, undeveloped potential for energy recovery exists at municipal wastewater treatment plants
Characteristics	**Transmission requirements.** Biomass generation is usually sited near transmission or distribution lines. **Dispatchability.** Biomass generating resources usually operate as baseload generation **Environmental attributes.** Most biomass fuel is a renewable resource, with low environmental impacts. Biomass generation does not add large net amounts of carbon dioxide to the atmosphere, but it does emit nitrogen oxides and particulate matter. Biomass generation based on conventional steam-electric turbine technology consumes significant amounts of water – up to 55,000 gallons per megawatt-hour, depending on fuel source and production technology.

Landfill Gas

Landfill gas is a product of the natural degrading and decomposition of municipal solid waste by anaerobic microorganisms in sanitary landfills. The gases produced, carbon dioxide and methane, can be collected by a series of low-level pressure wells and can be processed into a gas that can be burned to generate steam or electricity.

Landfill Gas	
Technology & Fuel	As organic materials in solid waste landfills decompose anaerobically, high concentrations of combustible gases are released. Landfill gas is composed of 50 to 60% methane; most of the rest is carbon dioxide. These gases can be put to productive use as fuel for generating electricity using internal combustion engines or combustion turbines. Generation capacity is usually 10 megawatts or less. Fixed and variable costs for landfill gas projects depend on the type of generating technology that is used. Smaller projects use internal combustion engines, while larger projects use combustion turbines.
Current Status & Outlook	Landfill gas is used to produce electricity at 380 landfills in the United States. Landfill gas generating projects use mature technologies. Future availability of opportunities to develop landfill gas generating projects will be influenced by the number and location of solid waste landfills.
Characteristics	**Transmission requirements.** Most solid waste landfills are already served by the local electrical transmission and distribution network. **Dispatchability.** Most landfill gas generating projects are operated as baseload resources in order to ensure that all gas is burned. **Environmental attributes.** Net environmental impacts are small. Landfill gas projects consume a fuel source that would otherwise be flared. Landfill gas may contain impurities that can create hazardous air emissions unless they are removed usually by filtration of the gas prior to combustion. Depending on where the landfill is located and neighboring land uses, noise may need to be controlled.

Geothermal

Geothermal is the only large renewable resource that provides base load generation, has a long-term firm fuel supply, and is scalable. While other renewable energy resources like wind and solar energy generate power intermittently, and hydro availability varies from year to year, geothermal operates over 95% of the time and may operate for 100 years or more.

Geothermal plants are typically built as 20 to 50 megawatt units, but modular systems are as small as 5 megawatts. The most likely locations in the Northwest are the Basin and Range geologic province that extends over southeastern Oregon and southern Idaho and the High Cascades. Binary technology was modeled for the 2008 IRP.

Geothermal	
Technology & Fuel	Geothermal energy is derived from heat that originates deep in the earth's crust. There are three basic types of geothermal generating technologies: dry steam, flash, and binary.
Current Status & Outlook	A Western Governors Association Geothermal Task Force Report identified nearly 1,300 megawatts of developable geothermal generation in Washington. The outlook for development of geothermal generating resources in the Pacific Northwest is unclear because extensive exploratory drilling has not been done. The most likely locations are in the parts of Basin and Range geologic province in Oregon and Idaho.
Characteristics	**Transmission requirements.** Sites with geothermal potential are located near City Light owned or controlled transmission. Upgrades to existing transmission system may be necessary. Geothermal is easy to integrate into a hydroelectric system because it has a high capacity factor. **Dispatchability.** Geothermal energy is usually operated as a baseload resource but it has some limited dispatchability on-peak and off-peak. **Environmental attributes.** Geothermal energy is a renewable resource. No fossil fuels are consumed, but the potential for release of gases (though low for binary), potential impacts to ground and surface water, and land use issues make it difficult to site in wilderness areas.

Natural Gas: Combined Cycle Combustion Turbines & Simple Cycle Combustion Turbines

Combustion turbine technology has been used to generate electricity for several decades. Natural gas technologies considered for the IRP are combined cycle combustion turbines (CCCTs) and simple cycle combustion turbines (SCCTs).

Natural Gas	
Technology & Fuel	A combustion turbine is a rotary engine composed of three basic parts. Air is taken in through a compressor and then natural gas is mixed with the air and burned in a combustion chamber. The resulting mechanical energy is then used to turn a turbine at a speed of 3,600 revolutions per minute. There are two types of combustion turbines. The combined cycle combustion turbine (CCCT) uses the combustion turbine to generate power and then recovers exhaust heat from the combustion turbine to make steam for a turbine generator that in turn produces additional power. The simpler and less fuel-efficient simple cycle combustion turbine (SCCT) generates power directly, without recovery of exhaust heat as in combined cycle turbines. CCCTs are more complex than SCCTs, and have higher capital costs. However, CCCTs are more fuel-efficient, with total running costs lower than for SCCTs. Both CCCT and SCCT projects are primarily fueled with natural gas.
Current Status & Outlook	In the Pacific Northwest, there is over 4,000 megawatts of CCCT generating capacity. The Northwest also has slightly more than 1,500 megawatts of SCCT generating capacity. High and volatile prices for natural gas have dramatically slowed the development of new combustion turbine generating projects. The outlook for natural gas prices is a significant source of uncertainty for CCCT and SCCT generating resources.
Characteristics	**Transmission requirements.** Siting requires access to a natural gas pipeline and electric transmission. **Dispatchability.** Combustion turbines are highly dispatchable. SCCT generating units can go from a cold start to full operation in less than 10 minutes. CCCT generating projects can be started up and shut down in a matter of hours. Combustion turbines operate at highest efficiency under full load. Because SCCT generating projects have higher operating (fuel) costs than CCCT generating projects, SCCTs are usually used to meet peak load requirements and provide standby for system reliability purposes. CCCT generating projects are normally used more for base load and mid-range purposes. **Environmental attributes.** Combustion turbines emit carbon dioxide (CO2), small amounts of sulfur dioxide (SO2), nitrogen oxides (NOx), and other air pollutants. Control technologies are used to eliminate most emissions of SO2 and NOx. CO2 production remains a major consideration. Also, some projects require large amounts of water, and there are impacts from fuel extraction and transportation.

Market Resources

A transmission grid system that serves the 11 states of the Western Region enables City Light to participate in many types of wholesale power market transactions. Seasonal exchanges and capacity purchases were the types of market transactions considered for the IRP, in addition to the long-term power purchases described in Chapter 2.

Seasonal Exchanges

A seasonal exchange is a power transaction that takes advantage of the seasonal diversity between Northwest (winter peaking) and Southwest (summer peaking) loads. City Light can transfer firm power from north to south during the Southwest's summer load season and from south to north during the Northwest's winter load season. Exchanges are an ideal solution in meeting the utility's seasonal resource needs since it enables the utilities in both regions to maintain less generating capacity than would otherwise be necessary. City Light's current portfolio includes a seasonal exchange with utilities in Northern California.

Exchanges are often done on a megawatt-hour for megawatt-hour basis, though the actual delivery schedules of firm energy in the exchange may vary. For example, one utility could deliver 25 aMW for four months of the year while the other utility delivers 50 aMW for two months of the year. In modeling exchanges, energy transfers were not megawatt-hour for megawatt-hour on a calendar year basis, since winter transfers to Seattle occur from November through February, bridging calendar years, while transfers during the summer months occur within the same calendar year.

When assessing exchanges in the modeling process, staff analysts first determined whether or not City Light has sufficient rights to firm transmission capacity available along the transmission path between the winter peaking utility (City Light) and the summer peaking utility (in, for example, California or the Desert Southwest). If sufficient firm transmission capacity did not exist, it was assumed that new transmission capacity would need to be constructed, with a minimum of seven years given before the exchange could begin. Any new transmission capacity required for the exchange was assumed to be a pro rata portion of an upgrade or new transmission line. This was ultimately considered as a cost of the exchange.

Another important consideration in assessing exchanges was ensuring that the total amount of energy City Light energy delivered during the summer months did not deprive City Light of energy it would need to meet growing summer loads in later years.

Capacity Purchases

A capacity purchase contract gives the buyer the right to a given amount of electric power at an established price. The contract usually identifies the generating resource(s). If and when the terms are exercised, the buyer takes delivery of power up to the maximum amount the contract specifies.

Seasonal capacity contracts are flexible as a resource and can ensure the availability of power when needed on a seasonal or temporary basis, without City Light bearing the full cost or risk of long-term resource ownership. The utility pays a fee to the owner of the generating resource for providing this service. If the utility exercises the contract terms, it pays the pre-negotiated price for the amount of power produced by the generator party to the contract.

A number of factors can affect the availability and costs of capacity purchases, such as the balance of supply and demand in the power market; price volatility in the market; prevailing prices when the contract is negotiated; and expectations of both the utility and the seller about the future of the power market. The greater the length of time before a capacity purchase is made, the less information is available about these factors and the price is higher.

In modeling capacity purchases, City Light considered purchasing them in different years throughout the 20-year planning horizon, mostly as a tool for balancing resource requirements. For planning purposes, the cost of the premium for a capacity purchase is estimated as the fixed costs of a simple cycle combustion turbine for the period covered by the contract, plus a return on investment for the turbine owner.

City Light does not view seasonal capacity contracts as a substitute for a generating resource, because there is more uncertainty about their long-term availability and cost. When planning for the years after 2012, capacity purchases are only used to bridge the gap in resources for a few years at a time in the candidate portfolios until load grows large enough to merit purchasing or building another generating resource.

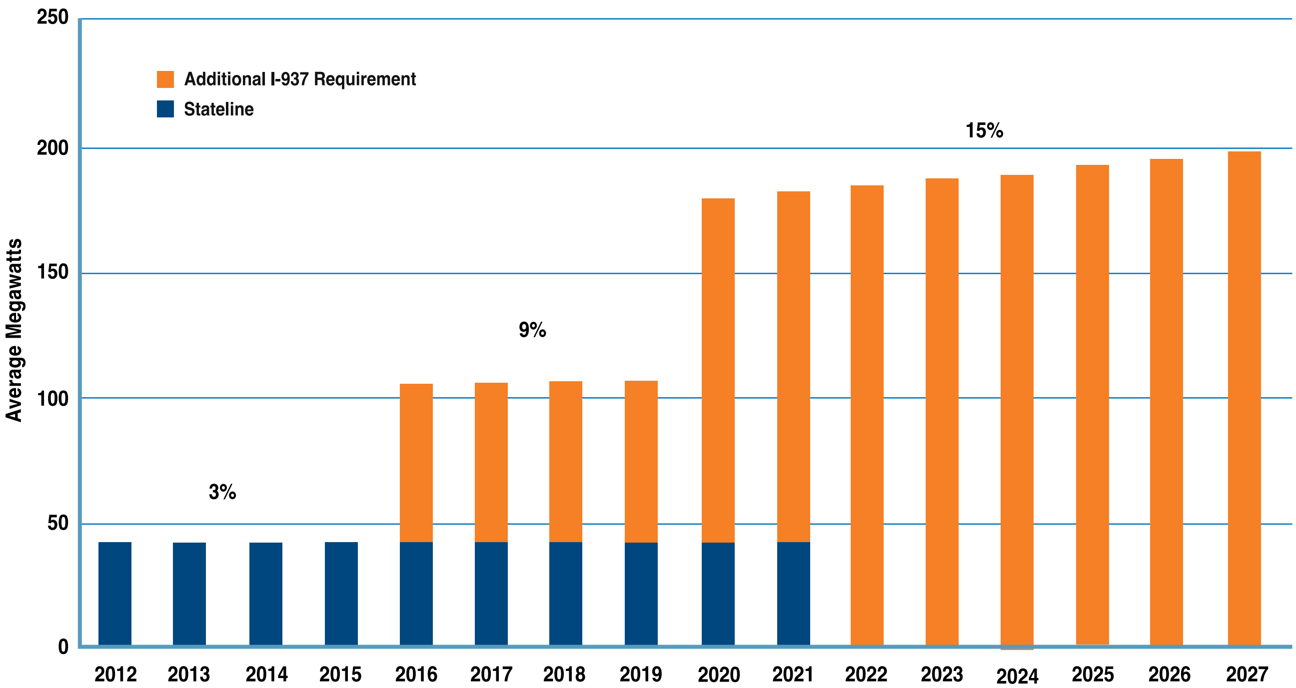
Resource Additions and Portfolio Design Considerations

In planning the 2008 IRP and considering new resources, City Light begins by examining the particular characteristics of each resource, e.g., cost, reliability, and so forth. We have also taken into account the requirements of Initiative 937, referenced throughout this report; Renewable Energy Credits (as they relate to I-937); and the future need for new transmission for new resources. These considerations are described below.

Initiative 937 Resource Requirements

Initiative 937, the Energy Independence Act, was passed by Washington voters in November 2006 and in large part dictates what resources City Light acquires after 2015. The chart below shows that City Light meets the renewable resource requirement through 2015 because of wind energy purchased from Stateline. Until then, resource adequacy drives acquisition choices, but afterwards the utility must meet both I-937 and resource adequacy requirements. The two sets of requirements are not complementary, and there may be times when City Light acquires new resources to meet I-937 requirements when it does not need them for resource adequacy.

Figure 4-1. I-937 Resource Additions



Renewable Energy Credits

Renewable Energy Credits (RECs) are tradable certificates that represent the environmental attributes of one megawatt-hour of electricity generated by a power plant that is a qualifying "renewable" resource under state law. The credits are also known as Green Tags, Renewable Energy Certificates (RECs), or Tradable Renewable Certificates (TRCs).

Qualifying resources include power generated with solar, wind, geothermal, tidal, wave, and biomass resources. Some states define hydropower as renewable. Washington state's definition of renewable resources includes only new hydropower generated in irrigation canals or as a result of certain efficiency-related investments at existing hydropower plants.

RECs can be purchased or traded so that the holder of the certificate can claim purchase or use of new renewable energy, despite having used power generated with large hydro or non-renewable resources. Electric utilities can use RECs to comply with state laws that require them to use a certain percentage of new renewable energy in serving retail customers.

In Washington state, the Western Renewable Energy Generation Information System (WREGIS) serves as the regulatory tracking system for RECs. Registration and tracking of RECs by WREGIS helps to ensure that RECs are properly assigned to their owners, are not double-counted and are retired after they have been consumed.

In addition to tracking, other organizations certify RECs as meeting important environmental and consumer standards. Seattle City Light certifies the RECs used in its voluntary "Green Up" program for retail customers with the Green-e Renewable Energy Program. The Green-e certification ensures that "Green Up" meets strict environmental and consumer protection standards established by the non-profit Center for Resource Solutions.

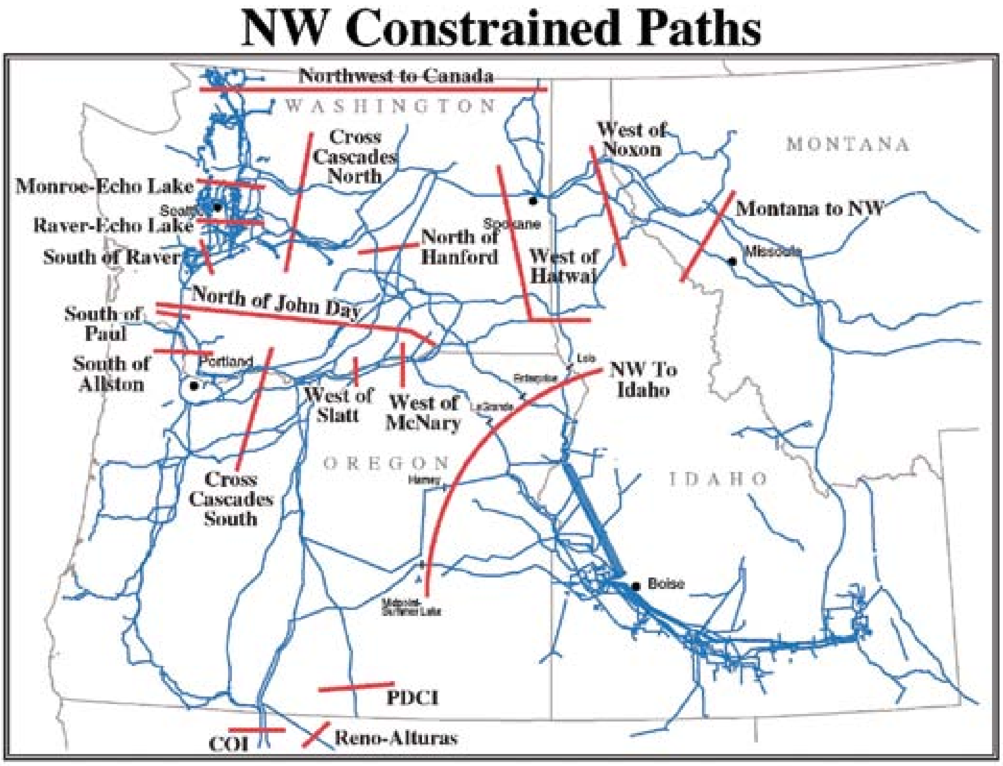
Washington state utilities can purchase RECs from qualifying renewable energy resources in Oregon, Idaho, and western Montana in addition to in-state. Washington state law will impose a $50/MWh fine (in 2006 dollars) for failure to have sufficient qualifying renewable energy or RECs to meet the state requirements under Initiative 937. REC prices in Washington today are primarily a function of the value placed upon them by voluntary buyers of RECs and out-of-state utility buyers who can use them to qualify for their own state renewable portfolio standards. This is expected to change at least one year before 2012, the first year of renewable resource requirements for I-937.

Of particular importance for City Light, a utility can be awarded non-tradable RECs for investing in many kinds of hydro efficiency projects. For each incremental MWh generated as a result of these efficiency measures, City Light receives one non-tradable REC. These non-tradable RECs can be used to meet I-937 requirements for renewable energy, the same as tradable RECs. City Light has and continues to make investments in efficiency measures at its hydroelectric plants. These measures may include structural changes, upgrades to turbines and runners, more efficient transformers, and other equipment. An example is City Light's planned efficiency improvement at the Gorge power plant, Gorge Tunnel II, described earlier in this chapter.

Transmission for New Resources

City Light owns only 657 miles of transmission facilities — primarily from the Skagit Hydroelectric Project to its service area — and a share of the Third AC Intertie. The utility is dependent upon access to transmission systems owned by others to reach the Western power market for balancing its seasonal power supply surpluses and deficits, as well as gaining access to new power supplies in the future. The capacity of the existing regional transmission system — of which approximately 70% is owned and operated by BPA — is almost fully subscribed, and available capacity on key transmission paths is extremely limited. The congested transmission paths, or flowgates, in the Northwest are shown on the map below.

Figure 4-2. Northwest Constrained Transmission Paths



As congestion in the Western grid continues to increase, existing firm transmission rights become more valuable and acquisition of new transmission capacity, from existing transmission providers, becomes more difficult. And as the transmission system ages, more frequent and longer duration maintenance outages are needed to maintain system capacities and prevent path deratings. Scheduled outages often cause inefficient management of generation resources.

Of utmost importance to City Light's long-term resource planning is whether new transmission facilities can be permitted and built, and whether or not the energy from distant, new generating resources can be delivered to Seattle. This section identifies issues associated with acquiring long-term firm transmission.

Transmission Contracts and Future Planning

City Light has long-term firm transmission contracts that provide Point-to-Point contract demand rights of approximately 2,000 MW. These rights are predominantly purchased from BPA under its FERC-compliant open-access transmission tariff (OATT) and provide distinct quantities of transmission capacity on a point-of-receipt (POR) to a point-of-delivery (POD) basis. These rights provide City Light with some flexibility to secure firm transmission for resources located to the east and south of Seattle. City Light also has transmission agreements for lesser quantities of transmission service with PacifiCorp, Idaho Power, Avista and Puget Sound Energy. City Light has reserved most of this transmission capacity for current operations by designating the plant capacity at the point-of-receipt, thus leaving limited transmission transfer capability available for use in acquiring future distant resources.

In the Pacific Northwest, BPA periodically convenes its stakeholders to assess transmission adequacy and seek solutions to both short-term and long-term congestion. BPA has developed both short-term and long-term firm methodologies that are used to evaluate new requests for transmission service. In 2007, a regional, coordinated planning and expansion effort that will augment the BPA planning process started. These efforts will address transmission system planning challenges including: determining how much transmission is needed and when; where transmission needs to be sited; who will own and control transmission facilities; how the costs of new facilities will be allocated; and what measures might forestall the need for construction.

Issues

City Light does not expect to directly site and develop transmission outside its service area. Transmission facilities required for new City Light generating resources probably will be built by other utilities; however, City Light has a substantial interest in resolving issues such as:

- Lack of available, long-term firm transmission capacity on Northwest transmission paths.
- Lack of clear responsibility for planning and constructing transmission facilities.
- Time required from planning to construction (average of five to ten years).
- Uncertainty about who will finance, build and pay for needed transmission.
- Uncertainty about costs and rates for new transmission.
- Multi-jurisdictional siting and permitting issues.
- Insufficient coordination between transmission and resource planning and development processes.
- Changes to open-access transmission tariff provisions.

To meet its resource adequacy criterion, City Light may need to build new generating resources in the Northwest if it cannot take advantage of seasonal diversity of power demand, such as importing from California or the Desert Southwest on a firm basis during the fall and winter to meet peak load requirements. The Northwest power market is seasonally surplus and energy prices may be depressed during the spring and summer when transmission congestion limits the ability to export surplus power to high demand regions. Such seasonal exchanges of power have historically made more efficient use of generating capacity in the Western Interconnection, but are constrained by the transmission system capacity limits. Transmission congestion can cause City Light to sell surplus power during the spring and summer when regional prices may be depressed, and purchase power during the fall and winter when prices are high.

Anticipated Need for and Estimating the Cost of New Transmission

City Light may need new or upgraded transmission facilities to transmit power from any additional resources to its service area, or to balance its power supply surpluses and deficits in regional power markets. New transmission also may be needed to improve reliability, or increase the capacity of the system to facilitate market transactions that reduce or defer the need for new generation sources.

Because long-term firm available transmission capacity (ATC) is based on forecasts, actual transmission requirements cannot be known until the capacity, location and operating characteristics of proposed new generating resources are identified. In general, generating plants farther from load centers are likely to impact more constrained paths and require more transmission capacity expansion than resources close to load centers.

The following table provides a summary of long-term firm transmission rates for transmission providers that may provide service for new generating resources.

Table 4-5. Long-term Firm Transmission Rates for New Generating Resources

PTP Transmission Rates for NW Providers			
Based on Rates Effective in 2007-2008			
		Ancillary Services	
	Firm PTP Rate ($/kW-mo)	Fixed ($/kW-mo)	Variable ($/MWh)
BPA	$1.2980	$0.2030	$0.5679
Avista	$1.4000	$0.2682	$ -
BCTC	$4.6700	$0.2606	$1.2850
Idaho Power	$1.7650	$0.1959	$ -
NW Energy Montana	$3.4200	$0.6100	$ -
PacifiCorp	$2.0250	$ -	$1.1660
Portland General	$0.5230	$0.2669	$ -
Puget Sound Energy	$0.2300	$0.2666	$ -

The Western Electricity Coordinating Council (WECC) has received a handful of requests from utilities and transmission project developers to construct and establish a transfer capacity rating for merchant transmission projects in the west. These projects may provide additional transmission capacity across constrained paths that will primarily be useful for seasonal exchanges. The price for service on these projects is not known at this time, but may be estimated based on the scope and estimate capacity rating of the project.

Designing Candidate Portfolios

After gathering information on the range of resources that might be added to City Light's existing resource portfolio, candidate portfolios were constructed in order to meet these objectives:

- Minimize the amount of resources needed to meet resource adequacy and I-937 requirements, largely by accelerating the acquisition of conservation.
- Use lower cost resources, such as exchanges and capacity purchases, in the early years to minimize the net present value of the cost of the portfolios.
- Avoid large resource commitments in the early years by using exchanges, capacity purchases and conservation.
- Produce portfolios that will meet the resource adequacy requirement and I-937 requirements.
- Use scalable resources when possible as opposed to separate projects (e.g., wind, geothermal, combustion turbines).
- Ensure that there is sufficient new generation in summer months to meet proposed seasonal exchanges.
- Avoid exchanges or resources in the early years that would require new transmission to be constructed on an unreasonably short timeline.

Once the portfolios were created, their performance was evaluated. Criteria for evaluation and the evaluation process are described in Chapter 5. Chapter 6 describes the results of two rounds of evaluation.